

**Proposed Agreement between California Energy Commission
and
University of California, San Diego**

Title: California Initiative for Large Molecule Sustainable Fuels
Amount: \$2,000,000.00
Term: 36 months
Contact: David Effross
Committee Meeting: 1/6/2011

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Natural Gas	Transportation	Alternative Fuels	\$2,000,000	\$2,000,000	\$0	0%

Recommendation

Approve this agreement with UC San Diego for \$2,000,000.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Conventional petroleum based transportation fuels (gasoline, diesel, jet) are nonrenewable, contribute to air quality degradation and climate change through carbon desequestration, and reliance upon them stands in the way of California's energy independence. Biofuels, liquid fuels produced from biomass, have the potential to replace petroleum as a source of transportation fuels, and by so doing address many of the problems associated with petroleum based fuels.

Large molecule drop-in fuels represent a promising and revolutionary set of technologies for reducing California's petroleum dependence, safeguarding our environment, and supporting the continued success of California's economy. These fuels are designed and engineered to be fungible with conventional fuels, i.e. transparent to the end users. As such, they are also compatible with existing infrastructure, obviating massive and disruptive investments in new bulk transportation, storage, and distribution systems.

Large molecule fungible fuels can be produced through a variety of technologies, including but not limited to biosynthesis (algae, bacteria, yeast), thermochemical processing of biomass, and processing of oil bearing farm crops. They offer Californians the following benefits:

- Reduced petroleum dependence and corresponding improvements in economic security.
- Reduced environmental and public health risks through reductions in greenhouse gas emissions and criteria pollutant emissions.
- Increased diversification of the transportation energy supply through fuels production via multiple pathways.

Background

Large molecule sustainable fuels represent solutions achievable within the next twelve to twenty years. The federal government already funds such research through NASA, DoD, and USDA, to name a few major efforts. Private capital has also been attracted.

California's interests in this nascent industry overlap, but are not congruent with, federal and private efforts. Specifically, the State has a stake in retaining our preeminence in this field of technology, creating green jobs through these technologies, and supporting those technologies best suited to California's unique needs. This includes meeting our own GHG, sustainability, and in-state sourcing mandates:

- The State Alternative Fuels Plan sets conventional motor fuels replacement goals of 9% in 2012, 11% in 2017, 26% in 2022.
 - The Bioenergy Action Plan establishes targets for the use and production of biofuels and biopower, and directed state agencies to work together to advance biomass programs in CA while providing environmental protection and mitigation. These targets are designed to:
 1. Maximize contributions of bioenergy toward achieving CA's petroleum reduction, climate change, renewable energy, and environmental goals.
 2. Establish California as a market leader in technology innovation, sustainable biomass development, and market development for bio-based products.
 3. Coordinate research, development, demonstration, and commercialization efforts across federal and state agencies.
 4. Align existing regulatory requirements to encourage production and use of California's biomass resources.
 5. Facilitate market entry for new applications of bioenergy including electricity, biogas, and biofuels.
- Specific targets of the Bioenergy Action Plan include in-state production of a minimum of 20% of California's biofuels by 2010, 40% by 2020, and 75% by 2050.
- AB 32 points holds transportation accountable for 39% of California's gross GHG emissions and mandates reductions.
 - The Low Carbon Fuels Standard (LCFS) directs fuel providers to reduce the carbon intensity of California transportation fuels, establishes sustainable demand for lower-carbon fuels, and mandates reduction in their carbon intensity of 10% by 2020, with greater cuts in the future.

The CILMSF represents a unique opportunity to pursue these goals with a world class interdisciplinary assemblage of scientists, engineers, and managers under the auspices of UCSD.

Proposed Work

The goal of this agreement is to promote research and development for renewable, low carbon, drop-in large molecule liquid fuels to meet California's transportation needs. In accordance with the State Alternative Fuels Plan, these large molecule fuels must be compatible with existing fuel refining and distribution infrastructure (hence the term drop-in), and production of these fuels should not compete with production of food. This ongoing R&D effort will be spearheaded by a new research initiative of the California Energy Commission operated in collaboration with the University of California, San Diego.

Establishing the California Initiative for Large Molecule Sustainable Fuels (CILMSF) will:

- further position California as a leader in the development and production of alternative renewable low-carbon fuels
- help to decrease the carbon footprint of transportation fuels in California, and
- help to establish a robust workforce training program that can supply the needed personnel for this new green collar industry.

For this new industry to be successful, it will require a diverse pool of well-trained technical personnel and professional scientists. In addition, investments in university-led basic research will be essential to developing the next generations of large molecule biofuel technologies and related materials.

The CILMSF will partner with regional and statewide economic and workforce development organizations, as well as the university and community college systems of California to help develop a robust curriculum to train scientists and technicians for the green collar jobs being created by the emerging biofuel industry. It will also facilitate the transfer of technology to the commercial sector, as well as interaction and collaboration with regional and state policy makers regarding the development of large molecule fuels for economic and environmentally sustainable energy production.

The CILMSF will operate from a platform of technology neutrality, involving research scientists from the fields of biology, chemistry, bioengineering and chemical engineering, with a primary mission to develop the knowledge, tools, and industrial practices that will allow the production of economically viable and fungible large molecule fuels from sustainable renewable sources. The research projects conducted as part of this initiative will use multi-disciplinary research teams that address the most significant barriers to economic viability of large molecule biofuels, while training the next-generation scientific and technical workforce essential to the future success of a sustainable renewable liquid transportation fuels industry in California.

The products of the CILMSF will be fourfold:

- 1) Development of advanced, near term tools, protocols and industrial processes to make renewable, fungible large-molecule fuels viable for large-scale commercial production.
- 2) Identification of existing challenges to the economic viability of large molecule fuel production from sources that do not compete with production of food, and an enhanced capability to effectively assess related emerging biofuel technologies.
- 3) A trained work force ready to staff this industrial sector as it develops.
- 4) Economically significant spinoff technologies and coproducts that will enable renewable production of a variety of bioproducts, such as:
 - a) green chemistry, including biological alternatives for existing environmentally unfavorable chemical processes
 - b) new wastewater remediation methodologies and processes
 - c) bio-polymers, including bio-plastics and biodegradable polymers
 - d) industrial enzymes
 - e) nutraceuticals

- f) enhanced animal feeds
- g) human & animal therapeutics

Justification and Goals

This project "[will develop, and help bring to market] advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers" (Public Resources Code 25620.1.(b)(1)), (Chapter 512, Statutes of 2006)).

This project also addresses the Intergrated Energy Policy Report, The State Alternative Fuels Plan (AB 1007), The Bioenergy Action Plan, AB 32, AB 118, and the Low Carbon Fuel Standard (LCFS).

This will be accomplished by:

- Analyzing life cycle potential of large molecule renewable fuel (LMRF) organisms and production processes
- Road mapping to identify new technologies and biofuel sources
- Developing high throughput technologies for rapid LMRF characterization
- Developing a genetic toolbox for biofuel organisms
- Developing metabolic engineering tools for biofuels organisms
- Developing biofuel organism protection strategies
- Developing improved harvesting and extraction techniques for LMRFs
- Developing co-products for improved economic viability of biofuel organisms
- Developing technologies to optimize nutrient utilization and recycling in biofuel organisms